

RESEARCH ARTICLE

Open Access

Assessment of Population Status and Diurnal Behaviour of White-rumped Vulture, *Gyps bengalensis* (Gmelin, 1788), in Ghachowk, Kaski, Nepal

Anju Koirala¹, Tej Kumar Shrestha², Rajeev Joshi^{3*}, Ganesh Paudel⁴, Kamal Raj Gosai⁵, Suman Ghimire³

¹Clean Energy Nepal, Mahalaxmasthan, Lalipur-44600, Nepal.

²School of Natural Sciences, Massey University, Albany Campus, Palmerston North, New Zealand.

³College of Natural Resource Management, Faculty of Forestry, Agriculture and Forestry University, Katari-56310, Udayapur, Nepal.

⁴Department of Forests and Soil Conservation, Government of Nepal, Kathmandu-44600, Nepal.

⁵Tri-Chandra Multiple Campus, Tribhuvan University, Ghantaghar, Kathmandu-44600, Nepal.

(Received: 30 August 2023; Accepted: 10 November 2023)

Abstract

Vulture Safe Feeding Sites (VSFS) provide diclofenac-free food and create an ideal environment for long-term ecological research on vultures. This study determines the population status and investigates the diurnal behavior of White-rumped Vulture (*Gyps bengalensis*) at the Ghachowk VSFS in Kaski, Nepal. We deployed the absolute count method to determine population of White-rumped Vulture (*Gyps bengalensis*), while scan sampling was applied to investigate their diurnal behaviour. The observed population of *Gyps bengalensis* ranged from 34 to 65 individuals (with an average of 50 ± 10 , based on a sample size of 9). Throughout the daytime, a total of 1651 instances of 11 distinct activities were recorded for the species in 729 separate observations. The most frequent daytime behaviour observed was perching (28%) followed by preening (14%), basking (13%), scratching (13%) flapping (10%), flying (9%) and disturbance (7%). Other behaviors, like feeding, sleeping (roosting), fighting (competition), and bathing, were observed less frequently (<2% each). Perching occurred most frequently during heavy rain, accounting for 66% of the observations, and in the late afternoon, representing 36% of the instances. Basking was most commonly observed during partly sunny conditions, comprising 26% of the observations, and in the noon hours, representing 20% of the instances. Scratching behavior was most frequently observed during clear weather, accounting for 16% of the observations, and during cloudy conditions and in the morning, accounting for 14% of the instances. In the Ghachowk VSFS, other associated species with White-rumped Vulture were Red-headed Vulture *Sarcogyps calvus*, Egyptian Vulture *Neophron percnopterus*, and Slender-billed Vulture *Gyps tenuirostris*. This study plays a pivotal role in uncovering the conservation requirements especially in reducing social taboos of the tradition communities regarding this critically endangered species which needs strong social support for its long-term conservation.

Keywords: behavioral study, critically endangered species, vulture feeding sites

INTRODUCTION



Vultures found in Nepal are obligatory scavengers that belongs to Accipitride family and the Falconiformes order (Ward et al., 2008, Purohit & Saran, 2013). Vultures have unique adaptation to extremely low pH levels in their stomachs (Ogada et al., 2012) and digest carrion; both fresh and rotten dead animals easily (Harris, 2013). Among the nine species of vultures viz. White-rumped Vulture (*Gyps bengalensis*), Slender-billed Vulture (*Gyps tenuirostris*), Red-headed Vulture (*Sarcogyps calvus*), Indian Vulture (*Gyps indicus*), Egyptian Vulture (*Neophron percnopterus*), Bearded Vulture (*Gypaetus barbatus*), Himalayan Griffon (*Gyps himalayensis*), Cinereous Vulture (*Aegypius monachus*) and Griffon Vulture (*Gyps fulvus*) recorded from Nepal. White-rumped Vulture (WRV) is a resident species which is categorized as critically endangered at both national and global level (Inskipp et al., 2016, IUCN, 2023). The earlier studies on the population status of WRV depicts extremely high decline rate of the species in Nepal. For example, Chaudhary et al., (2012) reported 91% decreases in populations of the White-rumped Vulture in between 2000 and 2011 from the lowlands of Nepal. The primary cause for such catastrophic decline of vultures including WRV was the use of veterinary drug diclofenac for curing pain and inflammations in livestock (Oaks et al., 2004, Harris, 2013).

To provide diclofenac free food to vulture, Government of Nepal in collaboration with local communities, Bird Conservation Nepal have established seven Community Based Vulture Safe Feeding Sites (VSFS), which are also referred to as Jatayu restaurants or Vulture restaurants. The primary objective of these establishments is to offer Diclofenac-free food to vultures and create a suitable environment for conducting long-term ecological research on vultures. These VSFS acquire elderly and unproductive livestock from nearby communities, carefully storing them for a minimum of seven days to ensure they are free from diclofenac. Subsequently, the vultures are provided with these livestock after their natural demise (Paudel, 2012, Bhusal, 2018, DNPWC and DoFSC, 2023). In addition to this ban on the use of diclofenac for curing livestock and promotion of the vulture safe drug i.e., Meloxicam; declaration of vulture safe zone, captive breeding and release into the wild of WRV were the other major efforts intervened in Nepal for the conservation of this ecologically crucial species. Consequently, the wild population of this species seems to be partially recovered as illustrated by the monitoring data between 2013 to 2018 (Galligan et al., 2018). However, the species requires continuous monitoring in its prehistoric and potential habitats to ensure this partial recovery is not destroyed as there are other many emerging threats recognized as vital for the destruction of this population. For example, the use of six NSAIDs, namely ketoprofen, nimesulide, aceclofenac, carprofen, phenylbutazone, and flunixin, has been examined in various studies, including those focused on habitat loss and destruction, poisoning through baits and pesticides, electrocution, and collisions (Margalida et al., 2014; Rana et al., 2019; Bhusal et al., 2020; Galligan et al., 2020). This study illustrates the population status and examine the daily habits of the WRV at the Ghachowk Vulture Safe Feeding Site in Kaski, Nepal which is also the historical habitat for feeding, roosting and nesting of WRV.

MATERIAL AND METHODS

Study area

The Ghachowk Vulture Safe Feeding Site is situated in Ghachowk, specifically in Ward no. 3 of the Machhapuchhre Rural Municipality (Figure 1). It is located within the Annapurna Conservation Area, approximately 12 kilometers away from center of Pokhara city. The site's geographical coordinates are 28.304488° N Latitude and 83.945792° E Longitude, with an average elevation of 1074 meters above sea level. It was established in 2010 encompassing an area of 100 ropani (BCN, 2011). The site falls under the subtropical zone, with typical minimum and maximum temperatures ranging from -2 to 15 °C and 25 to 35 °C, respectively, with an annual rainfall of 3951.5 millimeters. In the study area, various tree species such as *Cedrela toona*, *Engelherdia spicata*, *Pinus roxburghii*, *Sapium insigne*, *Dalbergia sissoo*, *Bombax ceiba*, *Alnus nepalensis*, *Schima wallichii* and *Aegle marmelos* are commonly found.

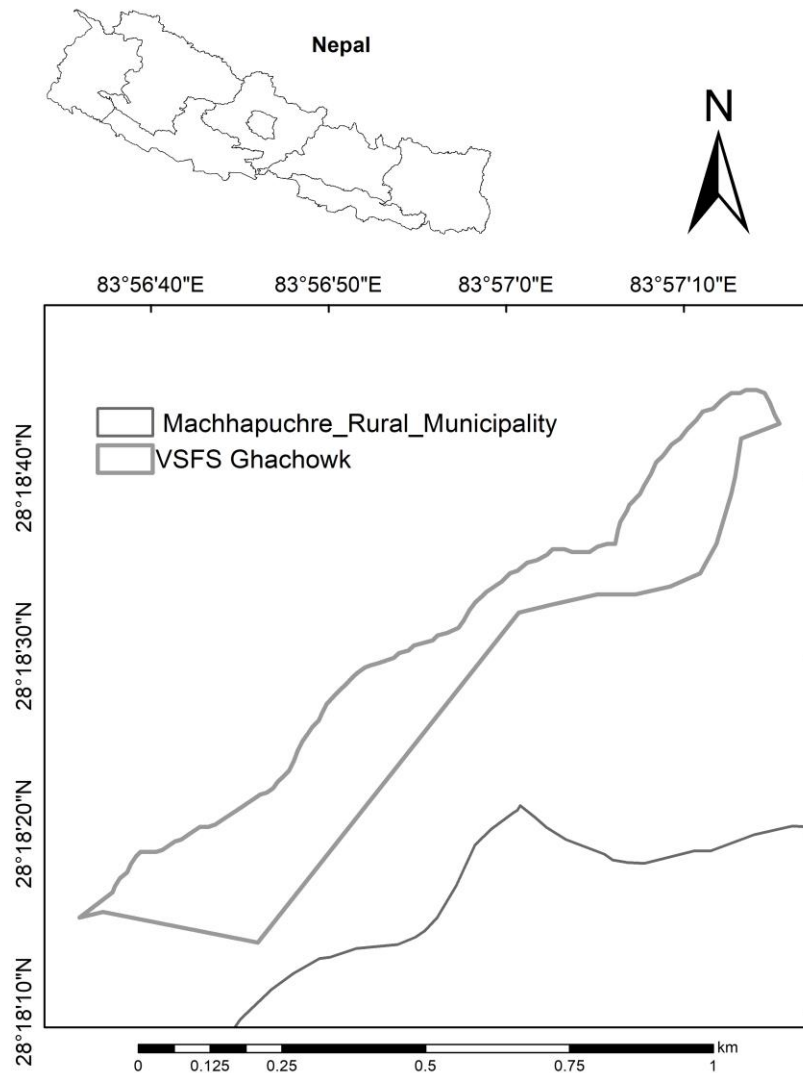


FIGURE 1. Location map of study area.

Population count

With the aid of an (8 × 42) Bushnell binocular, the direct observation method with absolute count approach was used to count the vulture population during the morning (06:00 hrs-11:00 hrs), afternoon (11:00 hrs-14:00 hrs), and late afternoon (14:00 hrs to 17:00 hrs). Counts were performed at least three times in each time slot.

Diurnal Behaviour

Systematically developed scan sampling method was used to acquire generic diurnal behaviour data (Altmann, 1974). A distinct flock of WRV was selected for behavior observation, which could be subsequently recorded on a data sheet. If the observed vulture was out of sight, another vulture from the same flock was observed and the recording continued in the same data sheet (Manandhar et al., 2019). Scan sampling consisted of two minutes of scanning activity followed by five minutes of break before the next scan was started. The vulture's general daytime behaviour was recorded for 15 days, with a total scan length of 82 hours and 48 minutes. The behaviour data was collected for a total of 729 times of observation, 538 times for adult WHV and 191 times for sub-adult WHV. A timer was used to measure the activity, and weather conditions were also observed and recorded.

Data analysis

The frequency of 11 different behaviours (Table 1) was computed by dividing the number of observations of each behaviour by the total number of observations (Table 1). To better comprehend weather-related activities, weather conditions were classified as sunny, partly sunny, clear weather (neither sun nor cloud), cloudy, sunny with light rain, light rain and heavy rain. To understand the activities in relation to the time of day, the day was divided into five parts: early morning (6:30 hrs to 8:30 hrs), morning (8:30 hrs to 11:00 hrs), noon (11:00 hrs to 13:00 hrs), afternoon (13:00 hrs to 15:30 hrs), and late afternoon (15:00 hrs to 17:30 hrs). Behavior records were included in the analysis which were observed for 2 minutes.

For data analysis, the Statistical Package for Social Sciences Statistics (SPSS) 20.0 edition was used. Chi square testings were performed to determine whether differences in observed vulture behaviour were likely to be associated with changes in weather conditions.

TABLE 1. Description of the daytime behaviours (activities) of vultures.

SN	Behaviour	Description
1	Feeding	Eat dead and decaying bodies
2	Resting	Wings wrapped around
3	Basking (sunning)	Stretch the neck and spread the wings fully (sometimes wing spread to only one side)
4	Scratching	Slightly scratching the body parts with the help of beak
5	Disturbance	By other vultures/chasing
6	Fighting/aggression	Any action with another vulture (competition)
7	Flight (flying)	Within the vulture safe feeding site
8	Flap	Fanning of wings
9	Sleeping (roosting)	Eyes closed
10	Bathing	Immerse wings, submerge head, stood straight in water and beaten their wings
11	Preening	Use of the beak to position feathers

RESULTS

Population status of Vultures

In Ghachowk VSFS, 77 to 132 (114 ± 18 , $n=9$) individuals of 9 species of vultures (White-rumped Vulture (*Gyps bengalensis*), Slender-billed Vulture (*Gyps tenuirostris*), Red-headed Vulture (*Sarcogyps calvus*), Indian Vulture (*Gyps indicus*), Egyptian Vulture (*Neophron percnopterus*), Bearded Vulture (*Gypaetus barbatus*), Himalayan Griffon (*Gyps himalayensis*), Cinereous Vulture (*Aegypius monachus*) and Griffon Vulture (*Gyps fulvus*) were observed. The recorded range of White-rumped Vultures varied between 34 and 65 individuals (with an average of 50 ± 10 , based on a sample size of 9). *Sarcogyps calvus* exhibited a range of 13 to 22 individuals (with an average of 17 ± 3 , based on a sample size of 9). *Neophron percnopterus* ranged from 0 to 4 individuals (with an average of 2 ± 1 , based on a sample size of 9). Finally, *Gyps tenuirostris* ranged from 29 to 49 individuals (with an average of 37 ± 6 , based on a sample size of 9).

Diurnal behavior of WRV

In total, 1651 events of White-rumped Vulture were observed during the daytime (6:30 hrs to 17:30 hrs) in 729 observations. The most frequent day time behaviour observed was resting (28%) followed by preening (14%), basking (13%), scratching (13%) flapping (10%), flying (9%) and disturbance (7%). Other behaviours, like feeding, sleeping, fighting, and bathing, were observed less frequently (<2% each) (Figure 2).

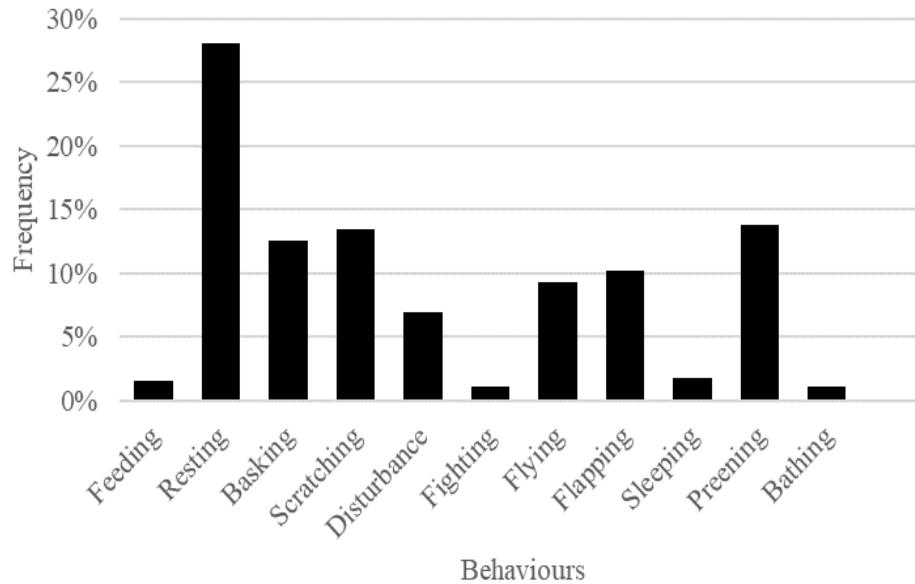


FIGURE 2. Daytime behaviour of WRV.

Behaviour pattern of WRV in response to weather

According to the Chi-square test, all ages of WRV's (χ^2 cal.=121.35 $p < 0.05$) behaviour depended on weather conditions, including adults (adult; χ^2 cal.=156.53) and sub-adult (χ^2 cal.=81.65 $p < 0.05$).

Sub-adult and adult WRV behaviour in response to weather

Resting was recorded in all-weather conditions and was most frequent in heavy rain (66%) followed by light rain (46%) and they were resting less during partly sunny (13%). Basking was most frequently (26%) recorded during partly sunny followed by sunny, with light rain (18%) and no basking (0%) during heavy rain. Scratching was the most frequent and equal during clear weather and cloudy (16%) followed by partly sunny. During clear weather conditions, disturbance behaviour was reported the most (10%) followed by cloudy, sunny and sunny, with light rain (7%). Disturbance was less frequent (1%) during light rain. Flight was most frequent during sunny with light rain (14%), followed by partly sunny and clear weather (13% each). There was no flight recorded during heavy rain. Flapping was the most frequent (13%) during light rain and least frequent (5%) during heavy rain. Preening was most frequent (18%) during light rain and less frequent during heavy rain (11%). Other behaviours such as feeding, fighting, sleeping, and bathing were almost the same with very less frequency (Figure 3a).

Adult WRV behaviour in response to weather

Resting was again the most frequent in adult WRV with 64%, followed by sunny with light rain (49%) and light rain (47%). They took less rest (12%) during clear weather. Basking was most frequent (21%) during partly sunny and less (0%) during heavy rain. Most frequent scratching (17%) was during clear weather and cloudy and less frequent (0%) during sunny with light rain. Disturbance was most frequent (9%) during clear weather and less frequent (0%) during sunny with light rain. Flight was most frequent (22%) during sunny with light rain and no flight (0%) during heavy rain. Flap was most frequent (13%)

during cloudy and non (0%) during sunny with light rain. Preening was frequent (22%) during light rain and less frequent (12%) during heavy rain. Preening was almost similar in all weather conditions. Other activities were most frequent during clear weather (Figure 3b).

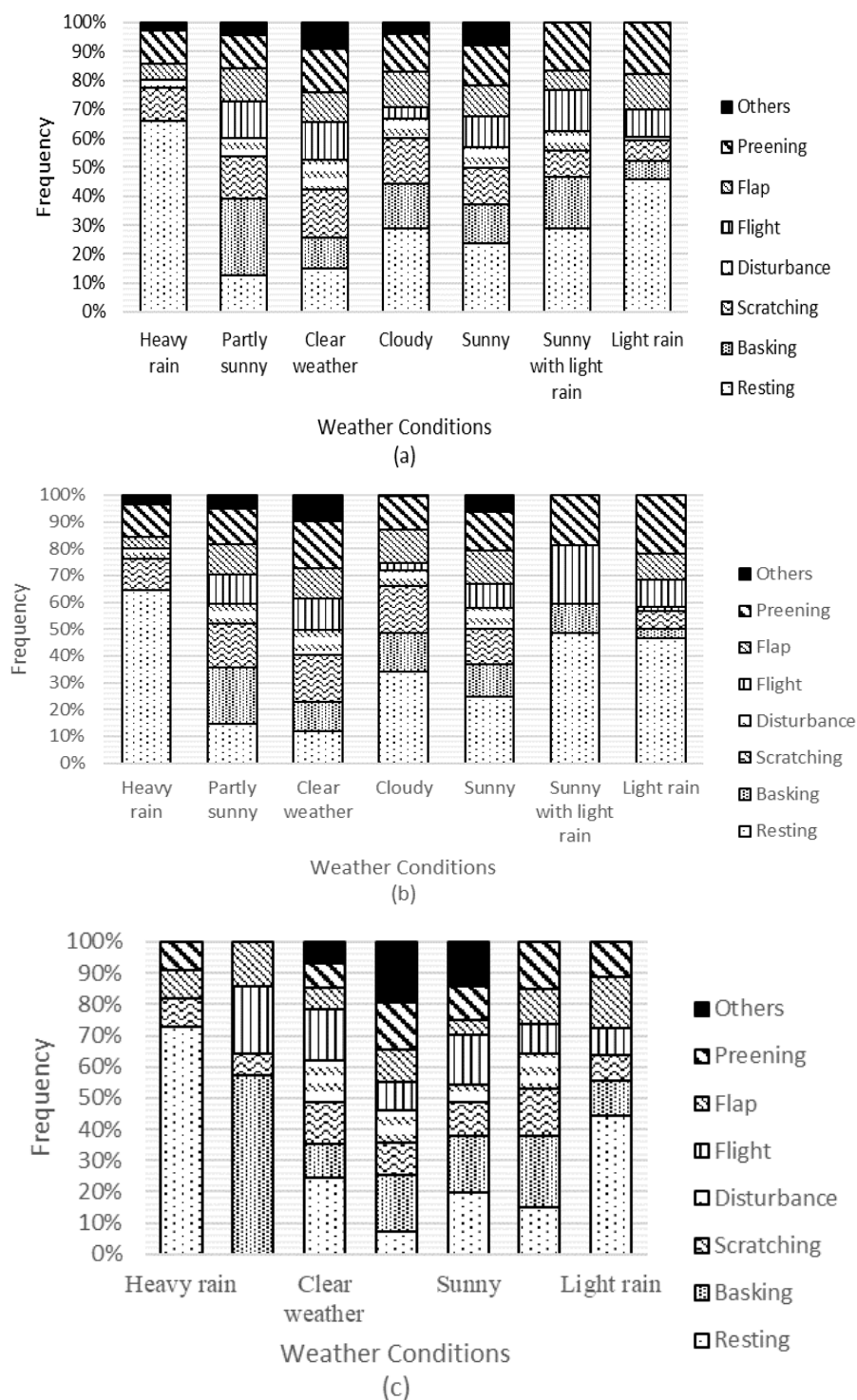


FIGURE 3. WRV behaviour in response to weather condition (a) adult & sub-adult frequency (b) Adult frequency & (c) Sub-adult frequency.

Sub-adult WRV behaviour in response to weather

Resting was again the most frequent in sub-adult WRV with 66% followed by light rain (46%). They took less rest (13%) during partly sunny. Basking was most frequent (26%) during partly sunny and less (0%) during heavy rain. Most frequent scratching (16%) was equal during clear weather and cloudy and less frequent (7%) during light rain. Disturbance was most frequent (10%) during clear weather and less frequent (1%) during light rain. Flight was most frequent (14%) during sunny with light rain and no flight (0%) during heavy rain. Flap was most frequent (13%) during light rain and less (5%) during heavy rain. Preening was frequent (18%) during light rain and less frequent (11%) during heavy rain. Preening was almost similar in all weather conditions the same as in adult. Other activities were most frequent (9%) during clear weather (Figure 3c).

WRV behaviour pattern in response to the time of day

Adult and Sub-adult WRV behaviour in response to Time of day

WRV was observed resting most frequently (36%) in the late afternoon and (35%) during the early morning and least (22%) in noon. Basking was most frequent (20%) during noon and least (9% each) in early morning and late afternoon. Scratching was observed the most (14%) in the morning and noon and least during the late afternoon (12%). Other vultures disturbed the WRV the most (9%) in the afternoon and least (6% each) in the morning and late afternoon. Flights were more frequent (11% each) at noon and late afternoon and less frequent (6%) in the early morning. Maximum (12%) flapping occurred during early morning, morning and late afternoon and minimum flap (8%) were recorded between noon and late afternoon. Preening was frequent (17%) during the early morning and less frequent (11% each) during noon and late afternoon. Other activities were most frequent during the morning session (Figure 4a).

Adult WRV behaviour in response to time of the day

Adult WRV was observed resting most frequently (37%) in the late afternoon, followed by (33%) in early morning and least (25%) in morning. Basking was most frequent (18%) during noon and least (8%) in the early morning. Scratching was observed the most (16%) in early morning and least (13% each) in the morning and late afternoon. Other vultures disturbed the WRV the most (9%) in the afternoon and least (5% each) in the early morning. Flights were more frequent (12%) at noon and less frequent (6% each) in the early morning and late afternoon. Maximum (13%) flapping occurred during the late afternoon and minimum flaps (8%) were recorded in afternoon. Preening was frequent (19%) during the early morning and less frequent (12%) during the late afternoon. Other activities were most frequent during the morning session (Figure 4b).

Sub-adult WRV behaviour in response to time of the day

Sub-adult WRV was observed resting most frequently (38%) in the early morning, followed by (34%) in the late afternoon and least (6%) in noon. Basking was most frequent (29%) during the afternoon and least (8%) in the morning. Scratching was observed the most (14%) in the morning and noon and least (3%) in the late afternoon. Other vultures disturbed the WRV the most (10%) in the afternoon and non (0% each) in the late afternoon. Flights were more frequent (41%) at the late afternoon and less frequent (5%) in the early morning. Maximum (13%) flapping occurred during the early morning and minimum flap (3%) were recorded in the late afternoon. Preening was frequent (19%) during the morning and less frequent (5%) during afternoons. Other activities were most frequent during noon (Figure 4c).

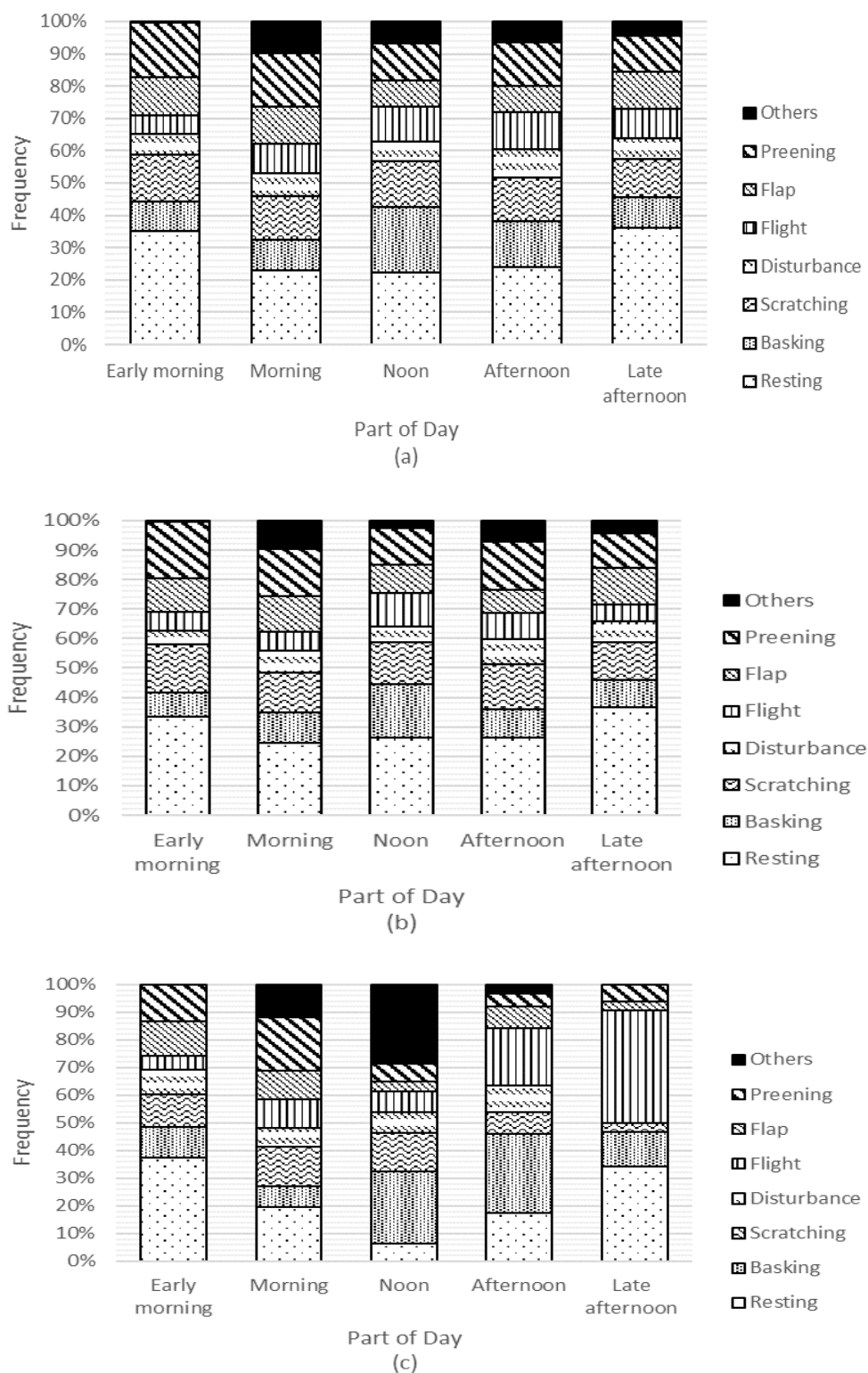


FIGURE 4. Frequency of WRV behaviour (a) adult and sub-adult, (b) adult, and (c) sub-adults at different times of the day

DISCUSSION

Population status

The White-rumped Vulture (WRV) stood out as the most prevalent vulture species within the Ghachowk Vulture Safe Feeding Site (VSFS). This prevalence of WRV in Nepal's VSFS may be linked to their status as residents within the country. Notably, the highest numbers of WRV were observed during the spring season in the VSFSs of Dang and Rupandehi, as documented by Dhakal in 2011. Both White-rumped Vultures and Slender-billed Vultures displayed their highest activity levels in the morning, followed by daytime and evening activities. In contrast, Red-headed Vultures exhibited their peak activity levels throughout the day, being less active during both morning and evening hours.

The presence of a large Vulture population at our study site could be attributed to the abundance of carcasses. Egyptian Vultures were less observed in VSFS in overall in Nepal (Parajuli, 2013). Egyptian Vulture was observed only twice in our site during our study. They were observed high during the evening but not recorded during the morning. Egyptian vultures usually feed after larger feeders, particularly Gyps species, have left the carrion (Kirk & Houston, 1995). They also eat rotten fruits and other debris from the disposal site. Chaudhary et al., (2010) recorded *G. bengalensis*, *G. tenuirostris*, *S. calvus*, *N. percnopterus*, *G. fulvus* and *G. himalayensis* in Nawalparasi. *G. himalayensis*, *G. fulvus*, *N. percnopterus*, *G. bengalensis*, *G. tenuirostris*, and *S. calvus* were recorded in Tanahun, adjoining district of Kaski. They reported a considerable number of *G. bengalensis*, followed by *G. himalayensis* and *S. calvus*.

Daytime behaviour of WRV

During the day, the WRV displayed a variety of behaviours with varying frequencies. Resting, preening, scratching, basking, flying, flap, and disturbance were all common in the study area. Resting was observed as one of the most common behaviours in WRV (Khatri, 2016). As per Khatri's research in 2016, it was found that basking accounted for the drying of approximately 70-80 percent of the moisture, while the remaining 20-30 percent was evaporated through the exposure to direct sunlight in the air. Our research found basking behaviour in trees, cliffs, and on the ground (bank of Seti River). All raptors appear to like sunbathing, not only for the warmth it gives, but also for the likely additional therapeutic effects. They frequently turn their back to the sun, fan their tails, and partially or completely spread their wings. In our study, WRV expanded their wings entirely or partially to warm up their bodies most of the time, but they did not flap their wings during rains.

Resting was observed in all weather conditions and times of the day. Similarly, scratching and preening behaviours were predominantly noticed during resting time. Raptors preen on a regular basis, not just after a bath, and will frequently interrupt a preening session by "rousing" or rising and vigorously shaking the entire plumage, or by stretching the legs and wings, usually on one side and then the other. The WRV was found disturbed by its competitor vultures while feeding and resting. Vultures wait for thermals to aid in their foraging behaviour, yet Red-headed Vultures were reported waiting near the carcass to feed it after the WRV and Slender-billed Vulture had left it (Gbogbo & Awotwe-pratt, 2008).

Information about behaviours such as drinking, bathing, and sunbathing does not have a high merit to be included in a literature. However, these behaviours are critical for maintaining the hygiene and health of birds (Tributsch, 2016), and several aspects of vulture behaviour remain a mystery. Bathing occurs on warm days (up to 34°C) as well as on cold days (down to 16°C). Vultures circle above the bathing area. According to earlier research, vultures have a unique ability to regulate their body temperature through urohydrosis (Houston, 1994; Snyder & Snyder, 1991). Because vultures' lives depend on the efficacy of their wings, feather upkeep is critical for these birds (Houston, 1994). Vultures bathe in streams, shallow ponds, or in the rain, which washes their feathers and may aid in their upkeep, particularly during rainy seasons (Ward et al., 2008).

CONCLUSION

The total individuals of all types ranged from 77 to 132 (114±18, n=9). *Gyps bengalensis* were recorded in the highest numbers. Resting (perching), preening, basking, scratching, and flapping were the most

frequent day-time behavior observed in *Gyps bengalensis* among 11 different types of activities. Day time behavior of different ages was significantly depending on the weather conditions and part of the day time. WRV rest most frequently in the late afternoon, basking was most frequent at noon, and scratching was most frequent at morning and noon.

WRV was observed resting most frequently (36%) in the late afternoon and (35%) during the early morning and least (22%) in noon. Basking was most frequent (20%) during noon and least (9% each) in early morning and late afternoon. Scratching was observed the most (14%) in the morning and noon. Studying the population and behavior of white-blended vultures is of utmost importance for conserving the vulture species and safeguarding their habitat. This type of research plays a critical role in ensuring their long-term survival and the preservation of their natural environment.

AUTHOR'S CONTRIBUTION

A.K. and T.K.S. designed the research. A.K. collected data and A.K., T.K.S. and R.J. analyzed data. T.K.S., R.J., G.P., K.R.G and S.G. prepared the manuscript. All authors gave approval for publication. There is no conflict of interests among the authors.

LITERATURE CITED

Altmann, J. (1974). Observational study of behavior: sampling methods. *Behaviour*, 49 (3): 227–267. DOI: <https://doi.org/10.1163/156853974x00534>

BCN. (2011). *The state of Nepal's Bird's. Bird Conservation Nepal and Department of National Parks and Wildlife Conservation, Kathmandu*. [http:// www.birdlifeneal.org](http://www.birdlifeneal.org) (accessed 22/12/2021).

Bhusal, K. P. (2018). Vulture Safe Zone: a landscape level approach to save the threatened vultures in Nepal. *The Himalayan Naturalist*, 1(1), 25–26.

Tributsch, H. (2016). Ochre bathing of the bearded vulture: a bio-mimetic model for early humans towards smell prevention and health. *Animals*, 6 (1): 7. DOI: <https://doi.org/10.3390/ani6010007>

Chaudhary, A., Subedi, T. R., Giri, J. B., Baral, H. S., Bidari, B., Subedi, H., Chaudhary, B., Chaudhary, I., Paudel, K. and Cuthbert, R. J. (2012). Population trends of Critically Endangered *Gyps* vultures in the lowlands of Nepal. *Bird Conservation International*, 22 (3): 270–278. DOI: <https://doi.org/10.1017/S0959270911000426>

Dhakal, H. (2011). *Sustainability of vulture safe feeding sites for the conservation of vultures in Rupanedhi and Dang, Nepal*. Tribhuvan University.

DNPWC and DoFSC (2023). Vulture Conservation Action Plan (2023-2027). Department of National Parks and Wildlife Conservation and Department of Forests and Soil Conservation, Babar Mahal, Kathmandu, Nepal.

Galligan, T. H., Bhusal, K. P., Paudel, K., Chapagain, D., Joshi, A. B., Chaudhary, I. P., Chaudhary, A., Baral, H. S., Cuthbert, R. J., & Green, R. E. (2020). Partial recovery of Critically Endangered *Gyps* vulture populations in Nepal. *Bird Conservation International*, 30(1), 87–102.

Gbogbo, F. and Awotwe-pratt, V. (2008). Waste management and Hooded Vultures on the Legon Campus of the University of Ghana in Accra, Ghana, West Africa. *Vulture News*, 58: 16–22.

- Harris, R. J. (2013). The conservation of Accipitridae vultures of Nepal: a review. *Journal of Threatened Taxa*, 5(2): 3603–3619. DOI: <https://doi.org/10.11609/jott.o2816.3603-19>
- Houston, D. C. (1994). Family Cathartidae (New World vultures). In J. Del Hoyo, A. Elliot, & J. Sargatal (Eds.), *Handbook of the birds of the world* (2nd ed.).
- Inskipp, C., Phuyal, S., Bhatta, T. R., Khatiwada, M., Inskipp, T., Gurung, S., Singh, P. B., Murray, L., Poudyal, L., & Amin, R. (2016). The status of Nepal's birds: the national red list series (Vol. 1). <https://doi.org/10.1111/cobi.12574>
- IUCN. (2013). *IUCN Red List of Threatened Species*. <http://www.iucnredlist.org> (accessed 14/07/2022).
- Khatri, P. C. (2016). The Ecology and Behaviour of Critically Endangered WhiteRumped Vulture (*Gyps Bengalensis*) in and Around Jorbeer Area, Bikaner. *International Journal of Research in Environmental Science*, 2 (4): 35–39. DOI: <https://doi.org/10.20431/2454-9444.0204003>
- Kirk, D. A. and Houston, D. C. (1995). Social dominance in migrant and resident turkey vultures at carcasses: evidence for a despotic distribution? *Behavioral Ecology and Sociobiology*, 36 (5): 323–332. DOI: <https://doi.org/10.1007/BF00167793>
- Manandhar, S., Shrestha, T. K., Maharjan, B. and Parajuli, A. (2019). Population Status and Nesting Behavior of Red-Headed Vultures (*Sarcogyps calvus*) at Dhorfirdi, Tanahun District, Nepal. *International Journal of Research Studies in Zoology*, 5 (3): 22–32. DOI: <https://doi.org/10.20431/2454-941x.0503003>
- Oaks, J. L., Gilbert, M., Virani, M. Z., Watson, R. T., Meteyer, C. U., Rideout, B. A., Shivaprasad, H. L., Ahmed, S., Chaudhry, M. J. I., & Arshad, M. (2004). letters to nature-Diclofenac residues as the cause of vulture population decline in Pakistan. *Nature*, 427(6975), 630–632.
- Ogada, D. L., Keesing, F. and Virani, M. Z. (2012). Dropping dead: Causes and consequences of vulture population declines worldwide. *Annals of the New York Academy of Sciences*, 1249 (1): 57–71. DOI: <https://doi.org/10.1111/j.1749-6632.2011.06293.x>
- Parajuli, S. (2013). *Feeding Behavior and Potential Threats to Vultures due to Aircrafts in Pokhara Valley*. Tribhuvan University.
- Paudel, K. (2012). Vulture Safe Zone (VSZ) in Nepal. *Gidda Sandesh: Vulture Bulletin*, 3–4.
- Purohit, A. and Saran, R. (2013). Population Status and Feeding Behavior of Cinereous Vulture (*Aegypus monachus*): Dynamics and Implications for the Species Conservation in and Around Jodhpur. *World Journal of Zoology*, 8 (3): 312–318. <https://doi.org/10.5829/idosi.wjz.2013.8.3.74148>
- Snyder, N. F. and Snyder, H. A. (1991). Bird. In *Birds of prey: natural history and conservation of North American raptors*. Still water: Voyageur Press.
- Ward, J., McCafferty, D. J., Houston, D. C. and Ruxton, G. D. (2008). Why do vultures have bald heads? The role of postural adjustment and bare skin areas in thermoregulation. *Journal of Thermal Biology*, 33 (3): 168–173. DOI: <https://doi.org/10.1016/j.jtherbio.2008.01.002>